Space Weather Technical Forecast

Issued on Monday, 27 March 2023 at 00:22 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of R1 Minor radio blackouts. Active electron fluence Likely.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with occasional minor C-class flares recorded at GOES16. These flares peaked with a C2.9 at 26/1708 UTC, with this appearing to emanate from the largest and most complex group on the Sun, AR3256. Activity around the time of this peak flare was part of a general brightening in near X-ray wavelengths around the southwestern sunspot groups AR3257, AR3259 and AR3256. There are now nine numbered sunspot regions on the visible disc including the above. AR3256 remains the only magnetically complex region on the disk, with all other regions relatively small, stable and magnetically simple. Perhaps the most notable event on coronagraphs of the 24 hours was an eruptive flare from AR3262 in the southeastern quadrant around 26/0500 UTC. This event has translated into ejecta seen heading largely south and east on coronagraphs, analysis showed a clear miss. So, at the time of writing no Earth-directed CMEs were observed in available coronagraph imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as measured at L1 by DSCOVR, showed Earth as transiting a negative polarity High Speed Stream from CH86/-, with the phi angle accordingly negative (towards the Sun) throughout. The solar wind speed was predominantly elevated between 550 km/s and 600 km/s, though briefly increased to near 700 km/s. The solar wind density was roughly level around 10ppcc observed, it did however increase to near 20 ppcc between 26/1200-1500 UTC. The IMF was at or below 8nT over the 24 hours, with the north-south component variable in character and with a +/-5nT range.
The net result of the above solar wind measures was for Quiet to Unsettled geomagnetic activity, with a provisional peak of '3+' in the 26/18-21 UTC interval.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) as measured at GOES16 remained at Background levels.
The high energy electron flux (greater than 2MeV) measured at GOES16 has remained at Moderate flux in the past 24 hours, with a peak of 746 pfu observed at 26/1650 UTC. The associated 24-hour fluence remained below the Active (1e8 integrated pfu) threshold, with a slight increasing trend. At 27/0001 UTC the observed fluence was 3.74e7 integrated pfu.

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Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is most likely to remain Low, but with a Chance of becoming Moderate with any isolated M-class flares. The main region likely to give such flares is AR3256 in the southwest.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs feature in the forecast. Earth is currently within a High Speed Stream from CH86/-. Wind speeds are likely to remain Elevated at first on day 1 (27th March) before beginning to slowly ease late on day 1 or into day 2 (28th). Geomagnetic activity should peak early in the forecast period with Unsettled (Kp3) intervals and a Chance of Active (Kp4), before becoming largely Quiet once again from day 2 (28 March) as the fast wind wanes. The next coronal hole expected to impact Earth is negative CH88/-. This appears slightly further west than on the previous rotation so it's possible we may see its HSS and perhaps a CIR late on day 4 (30th).

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is expected to remain at Background levels, but with a Slight Chance of reaching S1 or greater, should any significant flares occur.
The high energy (greater than 2 MeV) electron flux is currently moderate but is likely to rise further, probably breaching the 1000pfu High threshold at diurnal maximum each day through the period. The associated 24-hour fluence is expected is also expected to rise, with Active (1e8 integrated pfu) conditions becoming Likely from day 2 (Tuesday 28th March).

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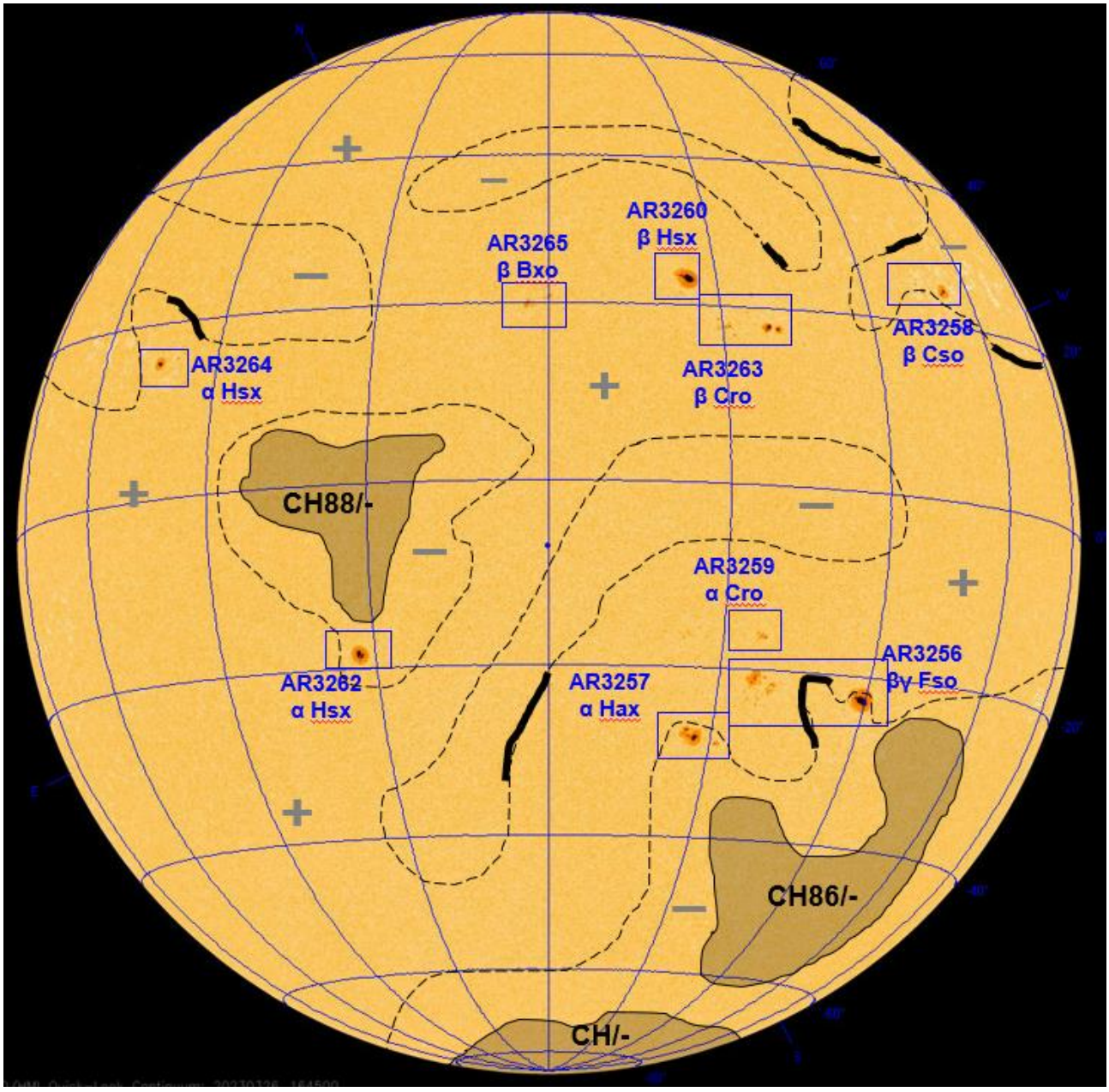
Figure 1. Solar Analysis Valid 26/1900UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

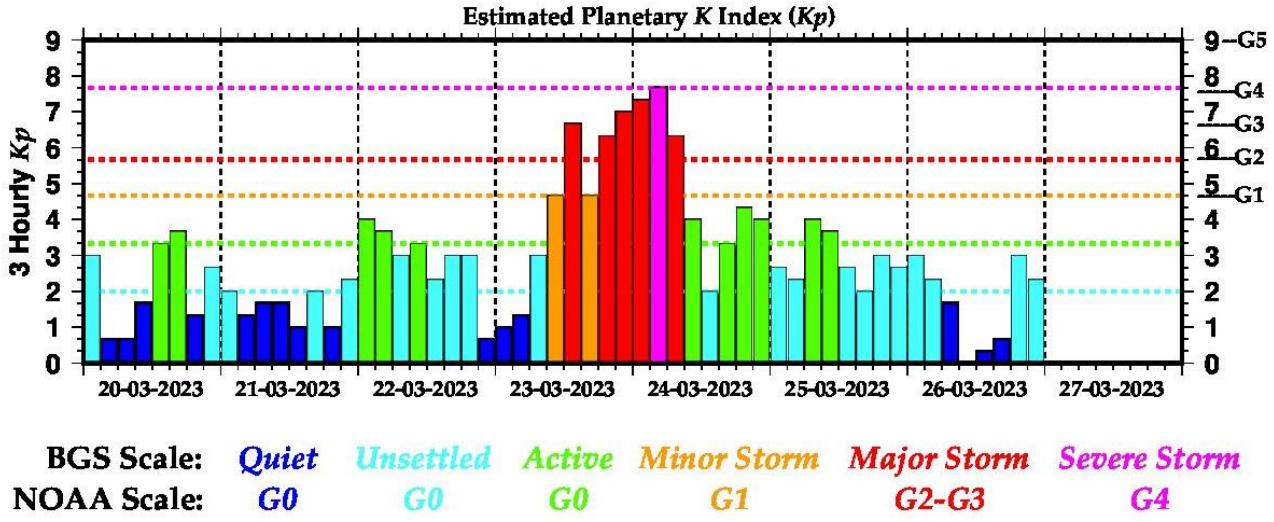
No Earth-directed CMEs feature in the forecast.

The current fast wind enhancement from CH86/- is expected to begin to ease later on day 1 (27th). MOSWOC Enlil has only a very tenuous grasp of solar wind conditions at present. The next coronal hole expected to impact Earth is negative CH88/-. This appears slightly further west than the previous rotation so it's possible we may see its HSS and possibly CIR late on day 4 (30th).
The chances of significant geomagnetic activity are now much-reduced relative to the recent past, with Unsettled periods possible and a Chance of Active at first on day 1, waning in earnest from late on day 1. Later on day 4 if we see the CIR from CH88/- geomagnetic activity is expected to increase to Unsettled with Active intervals and a slight chance of G1 minor geomagnetic storms.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	1	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections - Nil

Figure 2: BGS Estimated Planetary K index.



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Radio Blackouts - X-Ray Flares:

There are currently nine numbered sunspot regions on the visible disc. While only one of these sunspots is nominally large and magnetically complex, thus far the effect on X-ray activity has been muted for all sunspot regions. C-class activity has increased a little today and there remains a chance we will observe a moderate class flare.
Regarding the balance of front-side groups, none leave in the four days, while the Carrington locations for up to four regions are due. These do not yet feature in the forecast, with assessment as to any increase in risk they may deliver pending their arrival over the eastern limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	25	25	25	25
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

High energy proton flux (greater than 10MeV), as observed by GOES16 is currently at Background levels.
Proton flux is most likely to remain at Background levels, but with a Slight Chance of reaching S1 or greater should any larger flares occur. The current disc is perhaps under-performing relative to its potential in terms of flares, however the threat remains. Should the current cohort of sunspots begin to flare appropriately, the risk of S1 events may be adjusted upwards over the four days to account for their westward progress, with the rising risk otherwise too slight to show.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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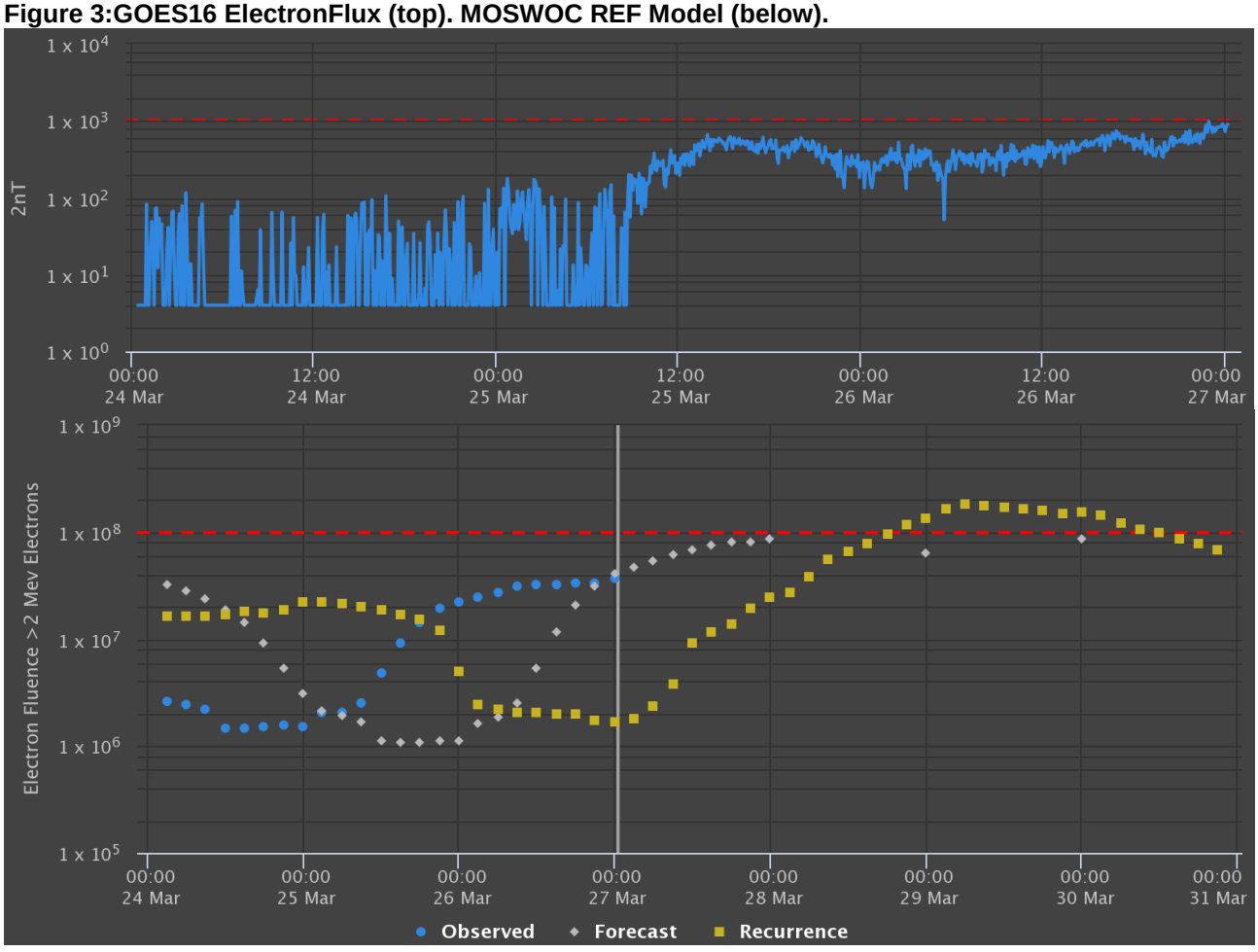
High Energy Electrons Event (≥ 2MeV):
The high energy (greater than 2 MeV) electron flux is now at Moderate levels. There is considered a reasonably strong potential for further day-on-day increases in flux during days 1 to 3 (27th-29th), possibly extending into day 4 (30th) of the four-day forecast period, with the 1000pfu High threshold now considered Likely to be breached at diurnal maximum each day in the expected absence of further significant geomagnetic activity.
Active 24-hour integrated electron fluence perhaps carries a Chance of being realised on day 1 (27th March). There is a likelihood that Active fluence levels will be reached on day 2 and 3 (28th-29th March), this reduces to a chance on day 4 (30th).

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}\,sr^{-1}\,day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	40	60	50	40
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3:GOES16 ElectronFlux (top). MOSWOC REF Model (below).



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